

1           1. A nerve regeneration conduit comprising a porous biocompatible support  
2 comprising an inner surface and an outer surface, the support being in the form of a roll  
3 such that a cross section of the roll approximates a spiral spanning from 8 to 40 rotations,  
4 with the outer surface of the support facing outward, relative to the origin of the spiral.

1           2. The nerve regeneration conduit of claim 1, wherein the support has a thickness  
2 of 5 to 200  $\mu\text{m}$ .

1           3. The nerve regeneration conduit of claim 1, wherein the support has a thickness  
2 of 10 to 100  $\mu\text{m}$ .

1           4. The nerve regeneration conduit of claim 1, wherein the support comprises a  
2 biological material.

1           5. The nerve regeneration conduit of claim 4, wherein the biological material is  
2 small intestinal submucosa.

1           6. The nerve regeneration conduit of claim 1, wherein the support comprises a  
2 synthetic polymer.

1           7. The nerve regeneration conduit of claim 1, wherein the support is  
2 bioresorbable.

1           8. The nerve regeneration conduit of claim 6, wherein the synthetic polymer is  
2 selected from the group consisting of polyhydroxyalkanoates, e.g., polyhydroxybutyric  
3 acid; polyesters, e.g., polyglycolic acid (PGA); copolymers of glycolic acid and lactic  
4 acid (PLGA); copolymers of lactic acid and  $\epsilon$ -aminocaproic acid; polycaprolactones;  
5 polydesoxazon (PDS); copolymers of hydroxybutyric acid and hydroxyvaleric acid;  
6 polyesters of succinic acid; polylactic acid (PLA); cross-linked hyaluronic acid;  
7 poly(organo)phosphazenes; biodegradable polyurethanes; and PGA cross-linked to  
8 collagen.

1           9. The nerve regeneration conduit of claim 1, further comprising a layer of cells  
2 adhered to the inner surface of the support.

1           10. The nerve regeneration conduit of claim 9, wherein the cells are Schwann  
2 cells or olfactory ensheathing glial cells.

1           11. The nerve regeneration conduit of claim 10, wherein the layer contains from  
2 15,000 to 165,000 Schwann cells per millimeter of conduit length.

1           12. The nerve regeneration conduit of claim 11, wherein the layer contains from  
2 20,000 to 40,000 Schwann cells per millimeter of conduit length.

1           13. The nerve regeneration conduit of claim 9, further comprising a layer of  
2 extracellular matrix material on the support.

1           14. The nerve regeneration conduit of claim 1, further comprising a hydrogel  
2 layer.

1           15. The nerve regeneration conduit of claim 14, wherein the hydrogel layer has a  
2 thickness of 5 to 120  $\mu\text{m}$ .

1           16. The nerve regeneration conduit of claim 15, wherein the hydrogel layer has a  
2 thickness of 10 to 50  $\mu\text{m}$ .

1           17. The nerve regeneration conduit of claim 14, wherein the hydrogel layer  
2 comprises a polymer selected from the group consisting of fibrin glues, Pluronics<sup>®</sup>,  
3 polyethylene glycol (PEG) hydrogels, agarose gels, PolyHEMA (poly 2-  
4 hydroxyethylmethacrylate) hydrogels, PHPMA (poly N-(2-hydroxypropyl)  
5 methacrylamide) hydrogels, collagen gels, Matrigel<sup>®</sup>, chitosan gels, gel mixtures (e.g., of  
6 collagen, laminin, fibronectin), alginate gels, and collagen-glycosaminoglycan gels.

1           18. The nerve regeneration conduit of claim 1, further comprising a multiplicity  
2 of microspheres.

1           19. The nerve regeneration conduit of claim 18, wherein the microspheres are  
2 immobilized in a hydrogel layer.

1           20. The nerve regeneration conduit of claim 14, wherein the hydrogel layer  
2 comprises a neurotrophic agent.

1           21. The nerve regeneration conduit of claim 18, wherein the microspheres  
2 comprise a neurotrophic agent.

1           22. The nerve regeneration conduit of claim 18, wherein the microspheres have a  
2 diameter of 1 to 150  $\mu\text{m}$ .

1           23. The nerve regeneration conduit of claim 18, wherein the microspheres  
2 comprise a material selected from the group consisting of a polyhydroxyalkanoate, a  
3 polyester, a copolymer of glycolic acid and lactic acid (PLGA), a copolymer of lactic  
4 acid and  $\epsilon$ -aminocaproic acid, a polycaprolactones, polydesoxazon (PDS), a copolymer of  
5 hydroxybutyric acid and hydroxyvaleric acid, a polyester of succinic acid; and cross-  
6 linked hyaluronic acid.

1           24. The nerve regeneration conduit of claim 23, wherein the microspheres  
2 comprise PLGA having an average molecular weight of 25 kD to 130 kD.

1           25. The nerve regeneration conduit of claim 24, wherein the lactic acid:glycolic  
2 acid ratio is approximately 85:15.

1           26. The nerve regeneration conduit of claim 18, wherein the microspheres are  
2 arranged in a pattern to facilitate creation of a neurotrophic agent concentration gradient.

1           27. The nerve regeneration conduit of claim 26, wherein the gradient is radial.

1           28. The nerve regeneration conduit of claim 26, wherein the gradient is axial.

1           29. The nerve regeneration conduit of claim 20 or 21, wherein the neurotrophic  
2 agent is selected from the group consisting of FK506,  $\alpha$ FGF,  $\beta$ FGF, 4-methylcatechol,  
3 NGF, BDNF, CNTF, MNGF, NT-3, GDNF, NT-4/5, CM101, inosine, spermine,  
4 spermidine, HSP-27, IGF-I, IGF-II, PDGF, ARIA, LIF, VIP, GGF, IL-1, and MS-430.

1           30. The nerve regeneration conduit of claim 20, wherein the hydrogel layer  
2 comprises two or more neurotrophic agents.

1           31. The nerve regeneration conduit of claim 21, wherein the microspheres  
2 comprise two or more neurotrophic agents.

1           32. The nerve regeneration conduit of claim 31, wherein the neurotrophic agents  
2 are in separate microspheres.

1           33. The nerve regeneration conduit of claim 31, wherein two or more  
2 neurotrophic agents are in a single microsphere.

1           34. A method of manufacturing a nerve regeneration conduit, the method  
2 comprising providing a porous biocompatible support comprising an inner surface and an  
3 outer surface; and forming the support into a roll such that a cross section of the roll  
4 approximates a spiral spanning from 8 to 40 rotations, with the outer surface of the  
5 support facing outward, relative to the origin of the spiral.

1           35. The method of claim 34, further comprising culturing a layer of cells on the  
2 support prior to forming the support into the roll.

1           36. The method of claim 34, further comprising depositing a hydrogel layer on  
2 the support before forming the support into a roll.

1           37. The method of claim 34, further comprising incorporating a multiplicity of  
2 microspheres into the conduit.

1           38. The method of claim 37, wherein the microspheres comprise a neurotrophic  
2 agent.

1           39. A method of facilitating regeneration of a transected nerve across a nerve gap  
2 defined by a proximal end of the transected nerve and a distal end of the transected nerve,  
3 the method comprising coapting the proximal end of the transected nerve to a first end of  
4 the conduit of claim 1, and coapting the distal end of the transected nerve to a second end  
5 of the conduit.

1           40. A method of facilitating regeneration of a crushed nerve, the method  
2 comprising providing a porous biocompatible support comprising an inner surface and an  
3 outer surface; culturing a layer of cells on the support; and rolling the support around the  
4 crushed nerve.

1           41. The method of claim 40, further comprising depositing a hydrogel layer on  
2 the support before rolling the support around the crushed nerve.

1           42. The method of claim 40, further comprising incorporating a multiplicity of  
2 neurotrophic agent-laden microspheres into the conduit.

1           43. The nerve regenerating conduit of claim 14, wherein the hydrogel further  
2 comprises cells.

1           44. The nerve regenerating conduit of claim 1, wherein the support further  
2 comprises spacer members extending from the inner surface of the support.

1           45. The nerve regenerating conduit of claim 1, wherein the support is loaded with  
2 one or more neurotrophins.

1           46. The nerve regenerating conduit of claim 45, wherein the one or more  
2 neurotrophins are distributed in a gradient in the support.